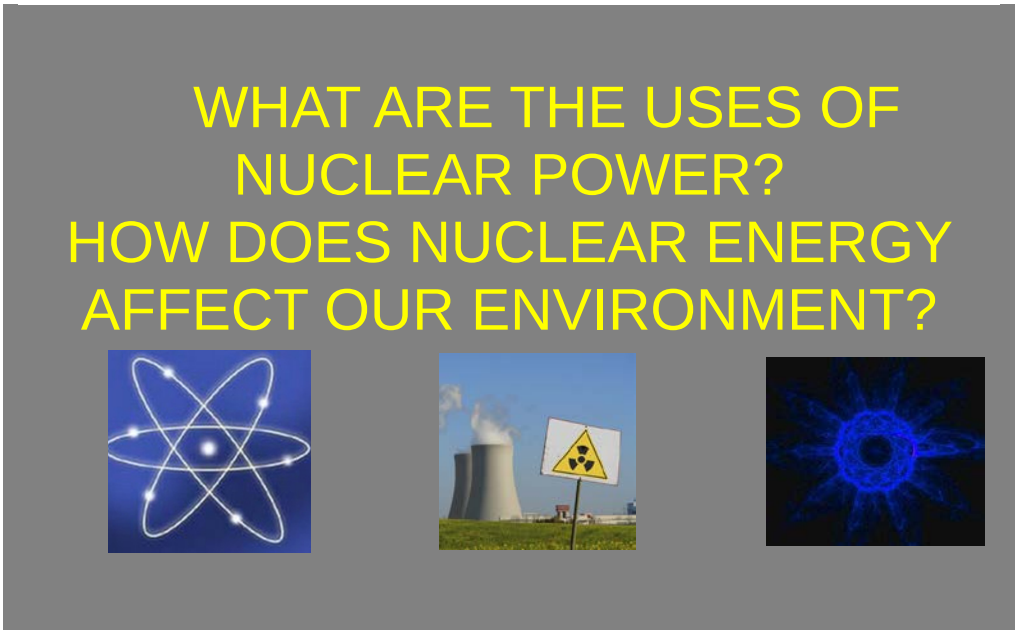
PROFILES IBSE Learning Module

Teacher Notes



Suggestions

Proposed for the Module lessons, the students are aware of the issues related to the basic of Nuclear Physics, mainly the structure of the atom and its nucleus. Also the students know the reaction of *γ* radiation characteristics of fission and its practical applications.

Theoretical background

The nuclear fission is a reaction which has the effect of breaking nucleus in two (or more) pieces of about the same mass, fast neutrons and heat radiation.
Elements which fission with thermal neutrons are called fissile materials (ex: ^{233}U, ^{235}U, ^{239}Pn, ^{241}Pu) and those which react through neutron capture transform themselves in fissile materials which are considered fertile (ex: ^{232}Th, ^{238}U).

The fission example for ^{235}U:

$$ {}_0^1n_{th} + {}_{92}^{235}U \rightarrow {}_{92}^{236}U^* \rightarrow {}_{56}^{144}Ba + {}_{36}^{89}Kr + 3{}_0^1n_{rapid} $$

The fission energy is distributed as a kinetic energy of the fission fragments, acting as particles with low mileage.

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The neutrons resulting from the fission fall into two groups: prompt and lagging. Those prompt are released with the fission fragments (FF) (even by the FF, after 10-14s) and max have been eliminated - 6 MeV, probable energy being 85 MeV - at the same time, issuing prompt γ radiation. Neutrons are emitted as lagging, produced by discharged circuit of nucleus which occurs as a result of the decay of β-FF.

The nuclear fission, also known as atomic fission, represents a process in which the nucleus of an atom is broken into two or more smaller nuclei, known as fission products and, naturally, a number of individual particles. Therefore, fission is a form of elementary transmutation. Individual particles are neutrons, photons (usually in the form of gamma rays) and other nuclear fragments such as alpha particles and beta particles. Fission of heavy elements is an exothermic reaction and may release significant quantities of energy in the form of gamma radiation and kinetic energy of the fragments (heating volume of material where fission takes place).

The nuclear fission is used to produce energy in power plants and in nuclear weapons explosions. Fission is useful as a source of power, as some materials, the nuclear fuel - on the one hand generates neutrons as "players" of the fission process and, on the other hand, are initiating fission impact neutrons. Nuclear fuels can be used in nuclear chain reactions self-sustained, issuing the energy quantities checked in a nuclear reactor or uncontrolled quantities, very fast, in a nuclear weapon.

The amount of energy released in a nuclear fuel is millions of times greater than the free energy contained in a similar chemical mass of fuel (petrol), thereby making a nuclear fission very tempting source of energy; However, the by-products of nuclear fission are highly radioactive, and may remain so even for thousands of years, having to deal with the important issue of nuclear waste. Concerns about the potential accumulation of waste material and huge destructive nuclear weapons collections counterbalance the desirable qualities of fission as an energy source, which gives rise to intense political debate on the issue of nuclear power.

The nuclear energy can contribute to the solution of energy problems which always facing the world in which we live. But the nuclear energy has a number of substantial advantages compared to conventional energy: Unlike coal and oil that pollutes the air, nuclear energy is very low and pollutant perfectly controllable: it degrades land, water pollution is perfectly controllable, unsigned, and the release of radioactive gases during operation of the reactors is deductible at levels acceptable restraint technology used in all modern reactors. The problem of radioactive waste remains a great responsibility for the future of mankind, as a considerable part of those wastes have a half-life that makes them dangerous for thousands of years and there is no generally accepted method of storing them.
Currently this issue is solved by storing the fuel consumed bars and radioactive waste in containers placed steel in salt mines, or vacated by entering bars in a material like glass, and their burial or storage of waste in construction on the surface, until they have found solutions and methods of geological damage.
Another issue is raised by the warmth that emanates through the reactor coolant water.

Nuclear energy production involves costs lower than coal. In this context the industrialized countries importing raw materials, oil and coal energy will reduce imports and thus help develop the economy.

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The use of nuclear energy in the peaceful energy is a great hope. You must remember that the thermal reactor systems represent a temporary contribution to our world's energy supplies for a period comparable to that of oil.
In the long term, we will have to resort to systems with fast neutrons, at generators which will cause nucleation to be able to contribute on the long solving the world's energy in other terms than does coal, but degrading much less the environment.
Nucleation raises other issues, however.

It is considered that the whole concept of development should be the priority of the nuclear energy insight in those regions where it proves to be effective and necessary economic conditions of the fuel balances, taking into account, of course, of the measures for enhancing the safety of nuclear power stations (CNE).
However, despite the undeniable benefits of new technologies, it raises ethical questions related to the possible negative impact on the environment, public health and society-in general-and its values.

References:

1. Turcitu, D., Panaghianu, M., Pop, V., Stoica, G., *Manual de fizică pentru clasa a VIII-a*, Editura Radical, Craiova, 2011.
2. http://ro.wikipedia.org/wiki/Fisiune_nuclear%C4%83

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